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UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF CALIFORNIA-FRESNO DIVISION

PACIFIC COAST FEDERATION OF FISHERMEN'S ASSOCIATIONS, *et al.*,
Plaintiffs,
v.
GINA RAIMONDO, *et a*l.,
Defendants.

THE CALIFORNIA NATURAL RESOURCES AGENCY, *et al.,*
Plaintiffs,
v.
GINA RAIMONDO, *et a*l.,
Defendants.

Case No. 1:20-cv-00431-JLT-EPG
Case No. 1:20-cv-00426-JLT-EPG

MICHAEL DEAS DECLARATION IN SUPPORT OF SACRAMENTO RIVER INTERVENORS' OBJECTION TO INTERIM OPERATIONS PLAN EXTENSION

Date: TBD
Time: TBD
Dept.: 5
Judge: Honorable Jennifer L. Thurston

DECLARATION OF MICHAEL DEAS

1. I, Michael Deas, declare that the following facts are true and correct and/or are based on my expert opinions.

2. I am a registered civil engineer in California. I specialize in hydrology, hydraulics, water temperature, water quality, and related areas. I am a Principal at Watercourse Engineering, Inc. ("Watercourse"), located at 424 Second Street, Suite B, Davis, CA 95616. Watercourse specializes in water resources planning and management, and water temperature and water quality analyses for federal, state, county, city, and other entities. I have been a Principal at Watercourse since its inception in 2001, and the company currently employs nine scientists and engineers. My qualifications to render the opinions contained in this Declaration are set forth in my professional resume, attached hereto as Exhibit A and incorporated herein by this reference.

3. Through my work experience, I am familiar with the Central Valley Project operated by the United States Bureau of Reclamation ("Reclamation") with regards to temperature management in downstream river reaches, including operation of Shasta Lake, the Shasta Dam temperature control device ("TCD"), Keswick Reservoir and downstream Sacramento River reaches, as well as other aspects of Reclamation's Northern District reservoirs (Whiskeytown Reservoir, Trinity Lake, Lewiston Lake) and downstream river reaches (Clear Creek and Trinity River). I have performed work for a variety of entities in these basins, including Reclamation, U.S. Geological Survey, Trinity County, and the Sacramento River Settlement Contractors. This work includes field monitoring, simulation modeling using a variety of models and approaches in support of a range of technical studies addressing flow, storage, reservoir cold water pool management, meteorology, operations, climate change, and other activities as they relate to water temperature management. In addition, I have completed related flow, temperature, and water quality studies and analyses in basins throughout California and in the Pacific Northwest that contribute to my understanding of flow and storage-related temperature management analyses.

4. Outlined herein is an analysis developed in cooperation with Lee Bergfeld, principal at MBK Engineers to evaluate the operation of Shasta Lake to meet alternative temperature targets in 2022 as opposed to those determined by the Shasta Planning Group under

the 2022 IOP. Three simulations were completed, commencing on March 22, 2022, at midnight, each with a starting storage of 1.719 million acre-feet and an initial vertical water temperature profile estimated as the average of the two profiles collected by Reclamation on March 15 and March 30, 2022. Meteorology was assumed equal to the 2015 field conditions, as were inflow temperatures to Shasta Lake. 2015 has been used in past forecasts in the Sacramento River system because it represents adverse meteorological conditions for reservoir and stream heating. Using this information and the hydrology and operations provided by Mr. Bergfeld, water temperature releases from Shasta Dam were completed using the U.S. Army Corps of Engineers model CE-QUAL W2[1] and the application of the model to Shasta Lake[2].

5. The first simulation was an operation of the TCD at Shasta Dam that attempts to meet the temperature targets described in the final temperature management plan ("TMP") submitted by Reclamation to NMFS on May 2, 2022. The second was an operation of the TCD that attempts to meet a temperature target of 56 degrees Fahrenheit (°F) in the Sacramento River upstream of Highway 44. A temperature target of 56°F upstream of Highway 44 is similar to the temperature management operation that occurred in 2015. Results from both simulations show a loss of temperature control at Shasta Dam occurs prior to the end of the temperature management season on October 31st. Results from the simulation with the temperature targets in the final TMP are generally consistent with results in the final TMP. The results from the simulation with a temperature target of 56°F upstream of Highway 44 show the loss of temperature control occurred over seven weeks later than the simulation with final TMP temperature targets. Finally, a third simulation was completed with a 56°F temperature target at Clear Creek, the temperature compliance location in 2014 and 2015, which shows the loss of temperature control occurred approximately four weeks later than the simulation with final TMP temperature targets. For the purposes of this report, the loss of temperature control is when the TCD operations transition to

[1] Cole, T.M. and S.A. Wells. 2008. CE-QUAL-W2: A Two-Dimensional Laterally Averaged Hydrodynamic and Water Quality Model, Version 3.6 - User Manual. Instructional Report EL-08-1. Prepared for the U.S. Army Corps of Engineering. Washington DC. August 2008.

[2] Deas, M.L., I.E. Sogutlugil, A.E. Bale, and S.K. Tanaka. 2020. Shasta Lake and Keswick Reservoir Flow and Temperature Modeling - Development Report. December 2020.

the side gates alone (and all other gates in the TCD are closed and both side gates are open), at which point typical TCD operations no longer provide a measure of operational control of Shasta Dam release temperatures. In 2022, the date corresponding to the side gates operating alone in actual operations was August 22.[3]

6. Each simulation has a different tailbay temperature to attain the downstream identified temperature target at the location (or locations). Heating rates from Shasta Dam, through Keswick Reservoir, and conveyance through the Sacramento River are based on historic conditions. The three simulations are presented as a comparative analysis, wherein model results are compared with model results to ascertain the relative difference between assumptions.

Figure 1. Three model simulations representing operations of the 2022 temperature management plan (TMP2022), to meet 56°F at Clear Creek (55F at CCR), and to meet 56°F upstream of Hwy 44 (SAC). Square symbols denote simulated loss of temperature control.

[3] Email from Thomas K. Patton, Civil Engineer, U.S. Bureau of Reclamation, to Michael Deas, Principle, Watercourse Engineering Inc., (Aug. 22, 2022, 09:50 PST) (on file with Declarant).

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Executed this 31 day of October, 2022, in Davis, California.

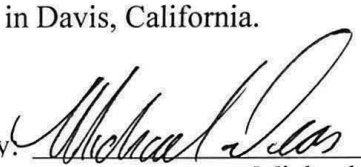
By: 
Michael Deas

EXHIBIT A

Michael L. Deas

Watercourse Engineering, Inc.
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Davis, CA 95616
(530) 750-3072
mike.deas@watercourseinc.com

EDUCATION

Doctor of Philosophy, 2000, University of California, Davis, Civil and Environmental Engineering
Major: Environmental Fluid Mechanics
Minor: Water Resources Planning and Management
Dissertation: Application of Numerical Water Quality Models in Ecological Assessment
Master of Science, 1989, University of California, Davis, Civil and Environmental Engineering
Major: Water Resources
Thesis: Unconfined-confined groundwater modeling of perched aquifers
Bachelor of Science, 1986, University of California, Davis, Civil Engineering

CURRENT POSITION

Principal, Watercourse Engineering, Inc.

BACKGROUND

Dr. Deas has extensive professional experience in the field of water quality monitoring, modeling, and analysis. His Ph.D. work focused on environmental fluid mechanics. He has taught water quantity and quality modeling courses at the University of California, Davis, and is a coauthor of a review of Central Valley water temperature modeling for the Bay Delta Modeling Forum As a consultant and researcher, he has continued to apply his education to a wide range of problems including surface flow, temperature, and water quality assessments; formulating conceptual models and identifying the interactions between aquatic system elements; developing and applying analytical tools as well as complex numerical models to evaluate flow and the fate and transport of physical and chemical constituents in aquatic systems; and providing technical presentations, both orally and in writing, for diverse audiences. He has worked throughout Central and Northern California on reservoirs, rivers, and estuaries.

Recent projects that Dr. Deas has worked on include:

- Development and application of a flow and temperature models for Shasta Lake and Keswick Reservoir spanning a simulation period 2000-2018. Models developed in a stakeholder process – a modeling technical committee – through approximately bi-monthly meetings detailing model selection, data, assumptions, calibration/validation, and other model development activities. Process included documenting all model results and distribution of final report.
- Development and application of a spatially and temporally detailed study of the Klamath River basin. These numerical models represent flow and full water quality conditions for multiple years on sub-daily time steps (e.g., hourly) at small spatial scales (e.g., 100 to 400 meters). The various modeling elements cover over 250 miles of the Klamath River, and over 110 miles of the Trinity River, including several reservoirs.
- Development of the Water Temperature Transaction Tool (W3T), a fully documented model, peer-reviewed model, adopted by the Oregon Department of Environmental Quality and applied in California, Oregon, Washington, Idaho and Montana.
- Development of logic for numerical/analytical modeling of organic matter, phytoplankton and benthic algae forms, pH and alkalinity representation, and topographic and riparian shading logic for water temperature simulations. Such logic has been used in several model applications and studies over the past few years.

PROFESSIONAL EXPERIENCE

Provided professional engineering services for water quantity and quality issues associated with river and reservoir systems. Project management activities include developing and managing budgets and schedules, allocation resources to complete work, oversight, and reporting. Typical project work includes:

- Basin-scale flow and water quality modeling for river and reservoir reaches in the Klamath River basin (PacifiCorp)

- Physical characterization of spatial and temporal variability of flow and temperature within thermal refugia for over-summering anadromous fishes on the Klamath River (U.S. Bureau of Reclamation in cooperation with the Yurok and Karuk Tribe).
- Flow and water temperature modeling (Water Temperature Transaction Tool, W3T) in support of instream flow transactions. (National Fish and Wildlife Foundation)
- Basin-scale water temperature modeling in the Tuolumne River (HDR, Inc.)
- Middle Fork American River Water temperature model representing river and reservoir systems (Placer County Water Agency)
- Shasta River Safe Harbor temperature modeling (Cal Trout)
- Shasta River and Big Springs flow and temperature assessment (The Nature Conservancy)
- Development and application of a Sierra Nevada region-wide temperature model (RTEMP) (U.C. Davis)
- Keno Reservoir water quality modeling and analysis assessing eutrophication status and remedy (U.S. Geological Survey and U.S. Bureau of Reclamation)
- Shasta River flow and temperature modeling for anadromous fish restoration (United States Fish and Wildlife Service and California Department of Fish and Game)
- Water quality model application to assess eutrophication potential within the Crystal Springs Reservoir complex (City of San Francisco for Merritt Smith Consulting)
- Central Valley water temperature modeling review (Bay Delta Modeling Forum)
- Trinity Lake, Lewiston reservoir, and Trinity River hydrodynamic and temperature modeling (U.S. Bureau of Reclamation, Trinity County)

Senior Engineer, Earth Science Associates, 1992-93.
Designed, constructed, tested, and applied a monthly operations model of the Los Angeles Department of Water and Power Mono Basin – Owens Valley Aqueduct System (Los Angeles Aqueduct Simulation Model). Implemented a long-term computer model maintenance program. Performed water supply analysis for various clients.

Consulting Engineer, Los Angeles Department of Water and Power - 1991, 1993.
Co-managed Mono Basin – Owens Valley computer modeling project. Formulated and implemented system operation model for Los Angeles' eastern Sierra Nevada water gathering facilities. Participated in a UCLA-Mono Basin public policy program mediation effort, and served on technical advisory committees for the State Water Resources Control Board (State Board) water rights re-issuance hearings for
Los Angeles. Testified before the State Board concerning predictive computer models for the Mono Basin and Owens River Basin.

Assistant Engineer, Aqueduct Division, Los Angeles Department of Water and Power, 1989-90.
Revamped and expanded the Mono Basin computer model from a spreadsheet to a FORTRAN program capable of assessing a wide range of scenarios. Conducted various studies examining the impact of alternative operations and hydrologic conditions on Mono Lake surface elevations and water supply to Los Angeles. Reviewed water rights issues and made recommendations to legal staff.

Civil Engineer, Hydrologic Engineering Center, U.S. Army Corps of Engineers, 1987.
Researched and formulated a report on the Corps responsiveness to the 1986 drought in the southeastern United States. The report, titled "Lessons Learned from the 1986 Drought" compiled information learned from the drought and presented specific recommendations for drought contingency planning.

RESEARCH EXPERIENCE
Co-Principal Investigator, Assessment of Restoration Actions on Big Springs Creek, Shasta River, California 2009-2010. University of California, Davis, Center for Watershed Sciences. 2008-10. Funded by National Fish and Wildlife Foundation.

Research evaluated the response of aquatic vegetation, geomorphology, hydrology, hydraulics, water temperature, water quality, and fish assemblage and habitat usage over a 12-month period from April 2009 through March 2010. Restoration response was assessed by comparing conditions identified during the project period (2009-2010) to pre-restoration conditions. The evaluation showed that post-restoration changes to the size and spatial extent of aquatic vegetation communities throughout Big Springs Creek were the primary agents behind critical restorative changes observed in the baseline monitoring elements, and had the greatest impact on stream morphology, water

temperatures, fish habitat, and fish ration – all important conditions for salmonids. Shared Principal Investigator (PI) role with Peter Moyle and Jeff Mount of U.C. Davis.

Co-Principal Investigator, Longitudinal Baseline Assessment of Salmonid Habitat Characteristics of the Shasta River, March through September, 2008. University of California, Davis, Center for Watershed Sciences. 2008-10. Funded by California State Water Resources Control Board.

The comprehensive longitudinal baseline assessment included detailed field observations of hydrology, geomorphology, water temperature, water quality, aquatic macrophytes, benthic macroinvertebrates, and salmonid habitat utilization. This integrated suite of physical, chemical, and biological observations provided a robust characterization of the necessary elements required to assess salmonid conditions in the Shasta River, as well as identify potential directions for restoration and maintenance of salmonids in the basin. Important in this research is that although discrete elements were assessed, the physical, chemical, and biological elements were highly integrated, with clear inter-dependencies important to salmonid restoration. Shared Principal Investigator (PI) role with Peter Moyle and Jeff Mount of U.C. Davis.

Co-Principal Investigator, Baseline Assessment of Salmonid Habitat and Aquatic Ecology of the Nelson Ranch, Shasta River, California Water Year 2007. University of California, Davis, Center for Watershed Sciences. 2007-09. Funded by U.S. Bureau of Reclamation.

Project presents a baseline assessment that identified the first multidisciplinary approach to studies in the Shasta Valley, providing a framework for an integrated evaluation of physical and biological factors affecting the various salmonid life stages present throughout an annual period. Shared Principal Investigator (PI) role with Peter Moyle and Jeff Mount of U.C. Davis.

Project Manager, Klamath River water temperature and water quality modeling project. University of California, Davis. (United States Fish and Wildlife), 6/95 – 12/99.
Application of hydrodynamic and water quality models to analyze water quality control alternatives designed to improve anadromous fisheries in the Klamath River downstream of Iron Gate Dam. Simulated dissolved oxygen, temperature, nutrients, and algal dynamics. Alternative included varying timing and quantity of reservoir releases as well as retrofitting outlet works to allow selective withdrawal for downstream temperature control.

Project Manager, Shasta River Flow and Temperature Modeling Project. University of California, Davis. (California State Water Resources Control Board, 205(j) Clean
Water Act Grant Program, 3/95 – 6/98.
Project included modeling flow and water temperature on the Shasta River for anadromous fish restoration efforts. Subtasks included hydrology, meteorology, water temperature data inventory and woody riparian vegetation inventory. Modeling included examining the impact of spring flow accretions, diversions, return flow, and riparian shading on this small river system. Designed and implemented temperature monitoring program.

Project Manager, Sacramento River Temperature Modeling Project. University of California, Davis. (California State Water Resources Control Board, 205(j) Clean Water Act Grant Program, 3/95 - 3/97.
Managed a team of engineers to implement and apply computer models to analyze the potential for temperature control in reaches critical for salmon reproduction downstream of Central Valley Project (CVP) reservoirs. Project team completed application of finite difference models of major CVP reservoirs – Lake Shasta and Trinity Lake; and implemented, calibrated, and verified one-dimensional finite element hydrodynamic and water temperature models for Keswick Reservoir, and the Sacramento and Feather Rivers.

Research Engineer, Putah Creek Coarse Sediment Evaluation below Monticello Dam (University of California, Davis Public Service Research Program), 6/95-8/96
Designed and completed field monitoring program to examine morphological changes to Putah Creek. Field work and associated research revealed that direct effects of Monticello Dam include creek aggradation due to tributary sediment contributions, as well as tributary down-cutting due to reduced post-project stream levels.

Project Manager, Willits Bypass Floodplain Study. University of California, Davis. (California Department of Transportation), 4/94 - 6/95.
Applied a two-dimensional finite element hydrodynamic model to an inundated floodplain with coalescing streams in Little Lake Valley near Willits, California. Verified and applied model for 100-year flood event to examined

impacts of alternative freeway alignments on floodplain dynamics. Determined over-crossings (bridge) and drainage requirements to maintain backwater effects to less than 1.0 feet, where possible.

TEACHING EXPERIENCE

Instructor, University of California, Davis, Extension. Current.
Critical Thinking – Instructor for training level class for working professionals in water resources. Subject matter focused on working definitions, critical thinking and science applications, and case studies.

Associate Instructor, Department of Civil and Environmental Engineering, University of California, Davis, Spring 1999, Spring 2001.
Environmental Quality Modeling (Civil and Environmental Engineering 244) – Instructor for graduate course addressing mathematical modeling of environmental water quality. Subject matter focused on structure, capabilities/limitations, sensitivity and reliability of water quality models as analytical tools.

Lecturer, U.S. Army Corps of Engineers. July 1999, July 2000.
Water and the Watershed – Hydrologic, Environmental, and Ecological Modeling.
Provided lecture and materials to Corp of Engineers' planners, economists, and biologists from district offices nationwide. Topics include fundamentals critical to computer modeling at the watershed level as well as case studies.

Associate Instructor, Department of Civil and Environmental Engineering, University of California, Davis, Fall 1997.
Unsteady Flow in Surface Waters (Civil and Environmental Engineering 277) –
Instructor for graduate course covering topics of unsteady flow. Subjects included long waves in surface flow, St. Venant equations, method of characteristics, explicit and implicit finite difference methods, stability of numerical schemes, and flood routing techniques.

Teaching Assistant, University of California, Davis, 1986-88, 1993, 1996.
Duties included preparing lectures, designing homework assignments, administering and grading tests, evaluating student performance, and assigning grades. Classes include:

- Engineering 3: Introduction to Engineering (lab)
- Engineering 35: Statics (discussion)
- Civil and Environmental Engineering 10: Introduction to Surveying (lab)
- Civil and Environmental Engineering 141L: Hydraulics (lab)
- Civil and Environmental Engineering 145: Design of Open Channel Structures (class)
- Civil and Environmental Engineering 152: Civil Engineering Planning (class)
- Civil and Environmental Engineering 271: Water Resources Planning Lab (class)

COMPUTER SKILLS

Programming: FORTRAN
Water Resources Related Software: RMA2, RMA11, HEC-5Q, CE-QUAL-W2, ADYN, RQUAL, WQRRS, QUAL2-R1, QUAL2K, CE-QUAL-RIV, W3T, HeatSource, MINTEQ.

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Power, M.E., S.J. Kupferberg, S.D. Cooper, and M.L. Deas. 2016. Chapter 33. Rivers. In H. Mooney and E. Zavaleta (Eds), Ecosystems of California (pp 713-754). Oakland, CA: University of California Press.

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Willis, A.D., A.L. Nichols, C.A. Jeffres, A.C. Fowler, C.A. Babcock, M.L. Deas. 2015. Seasonal aquatic macrophytes reduce water temperatures via a riverine canopy in a spring-fed stream. Freshwater Science. 2017. 36(3):000-000.

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Oliver, A.A., R.A. Dahlgren, M.L. Deas. 2014. "The upside-down river: Reservoirs, algal blooms, and tributaries affect temporal and spatial patterns in nitrogen and phosphorus in the Klamath River, USA." Journal of Hydrology. 519, 164-176.

Nichols, A.L., A.D. Willis, C.A. Jeffres and M.L. Deas. 2013. *Water Temperature Patterns Below Large Groundwater Springs: Management Implications for Coho Salmon in the Shasta River, California.* River Research and Applications. Wiley Online Library. DOI: 10.1002/rra.2655.

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Null, S.E., M.L. Deas, J.R. Lund. 2009. "Flow and Water Temperature Simulation for Habitat Restoration in the Shasta River, California." *River Research and Applications*. May.

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State Water Resources Control Board. Delta Water Quality Modeling Science Work Group. Group: M.L. Deas (Chair), E. Danner, C. Foe, W. Fleenor, M. Guerin, E. Ateljevich, C. Enright, L. Thompson, J. Domogalski, P. Hutton. Purpose: produce a white paper identifying appropriate models, modeling, and intuitional framework to support long-term water quality modeling in the Delta related to Regional Board (V) nutrient objectives. 2015.

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State Water Resources Control Board. Mono Basin Facilitated Process. Technical team member. Purpose: address unresolved technical issues in the Mono Basin. 2013.

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CALFED Science Program. 2008. *Temperature Management and Modeling Workshop in Support of an Operations Criteria and Plan Biological Assessment and Biological Opinion*. Prepared for Michael Healey, CALFED Lead Scientist, by M.L. Deas (Panel Chair), P. Goodwin, S. Lindley, C. Woodley, and T. Williams. April 1.

CALFED Science Program. 2005. *Review of the Biological Opinion of the Long-Term Central Valley Project and State Water Project Operations Criteria and Plan*. Prepared for Johnnie Moore, Lead Scientist, California Bay-Delta Authority. Prepared by J.A. Lichatowich, J. Anderson, M. Deas, A. Giorgi, K. Rose, and J. Williams. December.

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PROFESSIONAL ACTIVITIES AND AWARDS

Advisory Committee, Department of Civil & Environmental Engineering, University of California, Merced, at large member (Current). Assist department faculty and staff in strategic areas of education, research, and outreach.
Klamath Basin Monitoring Program (KBMP) – steering committee (Co-chair (2016-2019)
California Water and Environmental Modeling Forum Steering Committee member (2002-present)
Hugo B. Fisher Award (2015). California Water and Environmental Modeling Forum
Peer Review of the California Department of Fish and Game San Joaquin River Salmon Population Model (2006), California Bay Delta Authority
Independent Science Review Team – Temperature Effects on Salmonids in the Lower Clackamas River, Oregon (2006), sponsored by Portland Gas and Electric
Peer Review Panel for setting temperature objectives for anadromous fish in the Stanislaus River: Chairman (2003-2004), CALFED
Nathaniel Bingham Memorial Award, U.S. Fish and Wildlife (2001)
Water Quality Modeling Panel: Member (1998), Klamath River Technical Working Group
Journal Peer Review, Water Resources Research (ongoing)

REGISTRATIONS, PROFESSIONAL SOCIETIES, AFFILIATIONS, AND LICENSES

Registered Professional Civil Engineer, State of California (1990), #45624
Sigma Xi – Member
American Society of Civil Engineers (ASCE)
American Water Resources Association (AWRA)
American Geophysical Union (AGU)
North American Lake Management Society (NALMS)
American Fisheries Society (AFS)
Society for Freshwater Science (SFS)